



EPRI's Water/Energy Sustainability Initiative

Robert Goldstein

New York Regional Energy-Water
Workshop

New York, NY, April 20, 2004

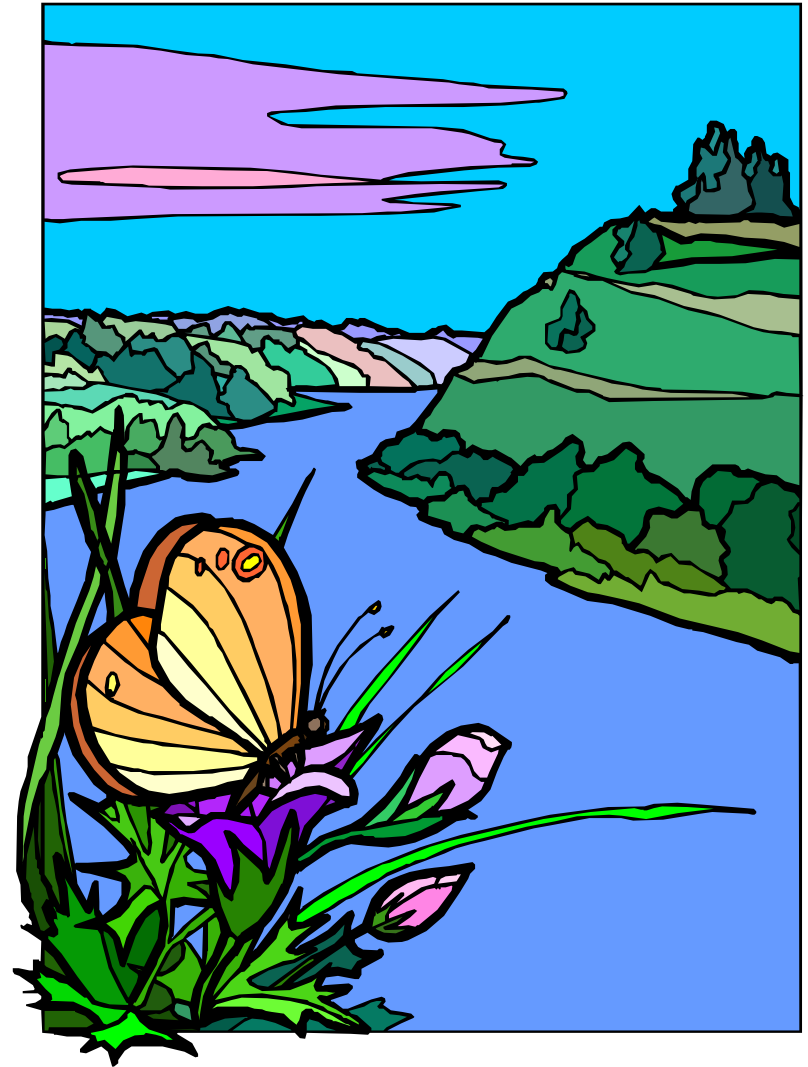
Ben Franklin



- When the well's dry,
we know the worth of
water.

Themes

- Why EPRI is interested in water sustainability?
- Why energy/water sustainability is a major emerging issue of national and international concern?
- What is EPRI doing?



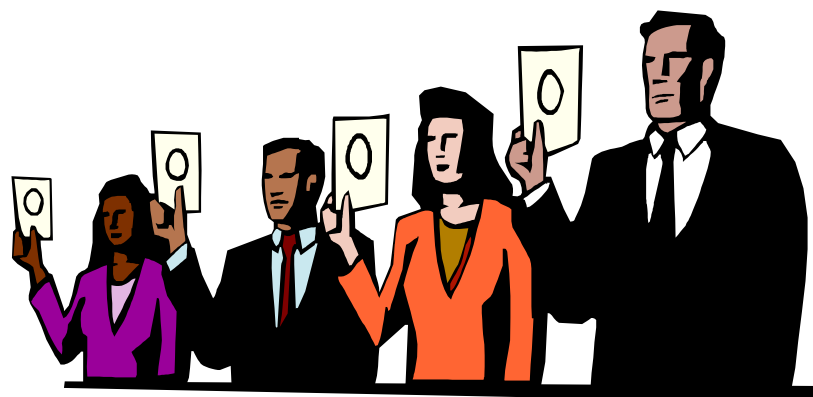
Why is EPRI involved in Water & Sustainability?



- 47 States in the U.S. reported drought conditions in August 2002.

GAO Survey of State Water Managers (2003)

- Under drought conditions, all 45 state water managers who responded to the GAO predicted water shortages that could be "accompanied by severe economic, environmental and social impacts."
- Water managers in 36 states surveyed by the GAO said they anticipate water shortages in the next 10 years under "average water conditions."



Water Issues in the News

Nation

• E-mail this story • Subscribe to the newspaper • Sign-up for e-mail news

05/10/2002 - Updated 06:57 AM ET

Deluge only dents East's drought

By Tracy W...

over the

region
rainfall after
the good
month.
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The World's Water 2000-2001

The Biennial Report on Freshwater Resources

- Water as a human right
- Water stocks and flows
- Water and food
- Desalination
- International watersheds
- Water recycling
- Dam removals
- Water events

Peter H. Gleick

THE WALL STREET JOURNAL MARKETPLACE

California's Needs for Water and Electricity Pit One Against the Other

By MARTIN KILIAN
andrew of the Wall Street Journal
In brief, it all boils down to water vs. water.
Authorities in the hot-dry Palm Desert east
of Los Angeles, desperate for more drinking wa-
ter, have proposed replenishing the area's under-
ground aquifers with water pumped from a Cal-
ifornia river canal. In the
same line, energy gi-
ant Calpine Corp. has
proposed to pump water
from the Colorado River
to the Palm Desert, to
supply 8,000 families a year. In a proposed
bill, the state's water commis-
sioner says that the water commis-
sioner of California has regu-
lated the use of scarce water
to generate power. But Calpine
says it would be a way
around the rules. It is locating the proposed
Palm Desert facility and two other power plants

Calpine has proposed siting
three power plants on Indian
reservations, exempt
from state water-use rules.

In the parched Southwest, an Indian reserva-
tion's sovereign territory exempt from state wa-
ter regulations.
Environmentalists and water regulators are
saying "California is a terribly water-
short state," says Gerald Mertz, executive di-
rector of the Planning and Conservation
League, an environmental group based in Sac-
ramento, Calif. "When faced with drought, there
will be tremendous water demand; the

last thing we need is to evaporate our fresh
water into the air."

Calpine spokesman William Highlander ad-
mits there will always be controversy
with the fresh-water issue, but he says Calpine
close the Indian reservations for several re-
asons, not just access to fresh water. He says the
area's cooperative power-plant operators of
the Pacific Northwest, Nevada and
Arizona, for in close proximity to high-vol-
tage transmission lines, allowing the main mar-
ket in the electricity grid linking the
states of Los Angeles and Las Vegas.

Add Calpine, Mr. Highlander adds, can't be
accused of insensitivity. The company already
operates three California power plants owned by
industrial wastewater, with two more water-
cooled plants in development. But that and
other reasons, some environmentalists consider

Technology: Verizon posts \$1 billion
loss for second quarter

Health: FDA orders Pfizer to pull
Lipitor ad, calling it 'misleading'

DOE News

RELEASE DATE: August 1, 2001 [Print Friendly Version](#)

Study Shows Efficient Appliances Yield Dramatic Energy and Water Savings

SWEET Study Reveals Significant
America

energy.gov
U.S. DEPARTMENT OF ENERGY

inside the DOE
press room



NATIONAL GEOGRAPHIC SPECIAL EDITION

Water

THE POWER, PROMISE,
AND TURMOIL OF
NORTH AMERICA'S
FRESH WATER

Price Fixing



Power Plant Water Issues in Today's News



- ***“Company Ends Fight for Power Generator on NJ-NY Border”***
 - The Record, NJ, September 2002
- ***“Official: Plants Would Use Too Much Water”***
 - The Idaho Statesman, ID, July 2002
- ***“Georgia Power Loses Bid to Draw Water from Chattahoochee”***
 - Miami News, February 2002
- ***“EPA Orders Mass. Power Plant to Reduce Water Withdrawals”***
 - Providence Journal, RI, July 2002

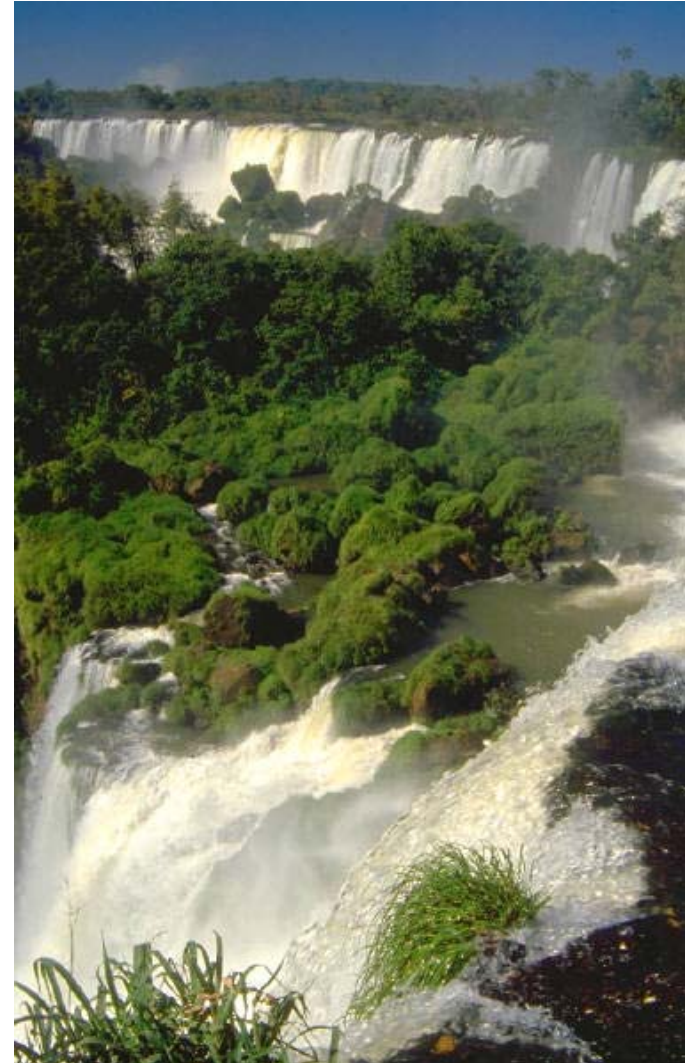
Power Plant Water Issues in Today's News

- *“Duke Power Warns Towns in Charlotte, N.C., Area to Cut Water Use”*
 - The Charlotte Observer, NC, August 2002
- *“Generating Plant to Put Recycled Water to Use”*
 - Inland Valley Daily Bulletin, CA, August 2002
- *“Water at Pueblo, Colorado, Power Plant Slows to Trickle”*
 - The Pueblo Chieftain, CO, August 2002



Water is a Critical Resource

- Fast growing demand for clean, fresh water
- Increased demand for environmental protection and enhancement
- All regions of US vulnerable to water shortages
- Water availability determines
 - Electricity supply and demand
 - Electricity grid topology
 - Societal and economic infrastructure sustainability

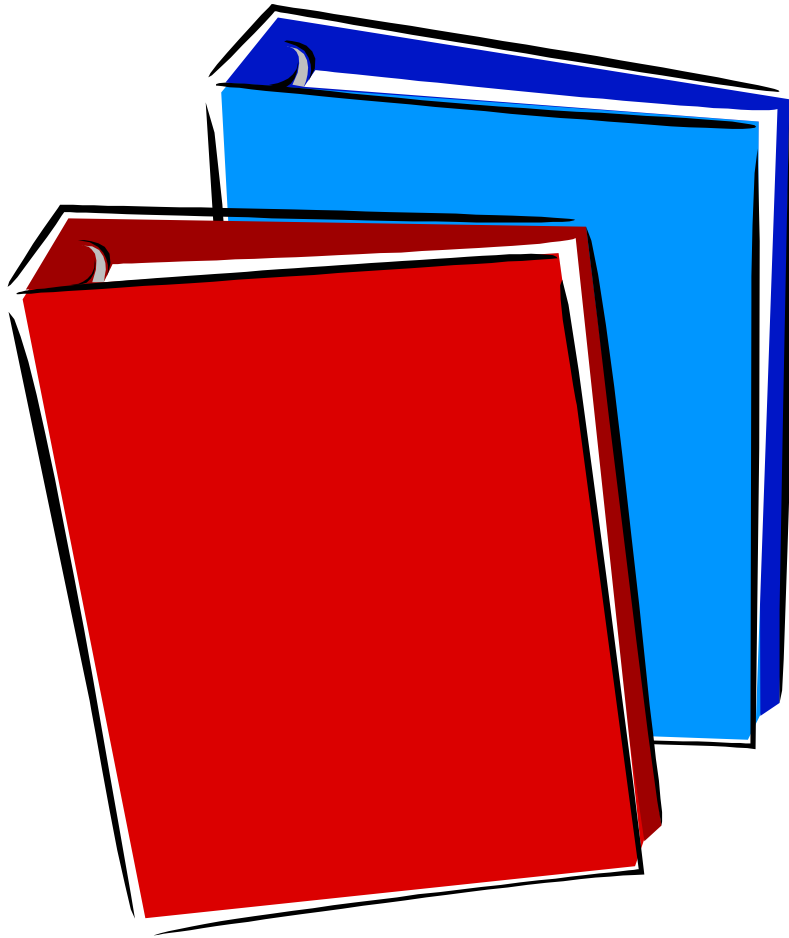


EPRI Water Resource Sustainability Initiative

- National and international (security) issue
- Integrated macroscale (region and watershed) and microscale (individual facility; e.g., power plant, sewage treatment plant, industrial plant, farm) approach
- Creation and application of
 - New technologies
 - Planning and management stakeholder-accessible tools
- Regional-based strategic partnerships



Scoping Reports



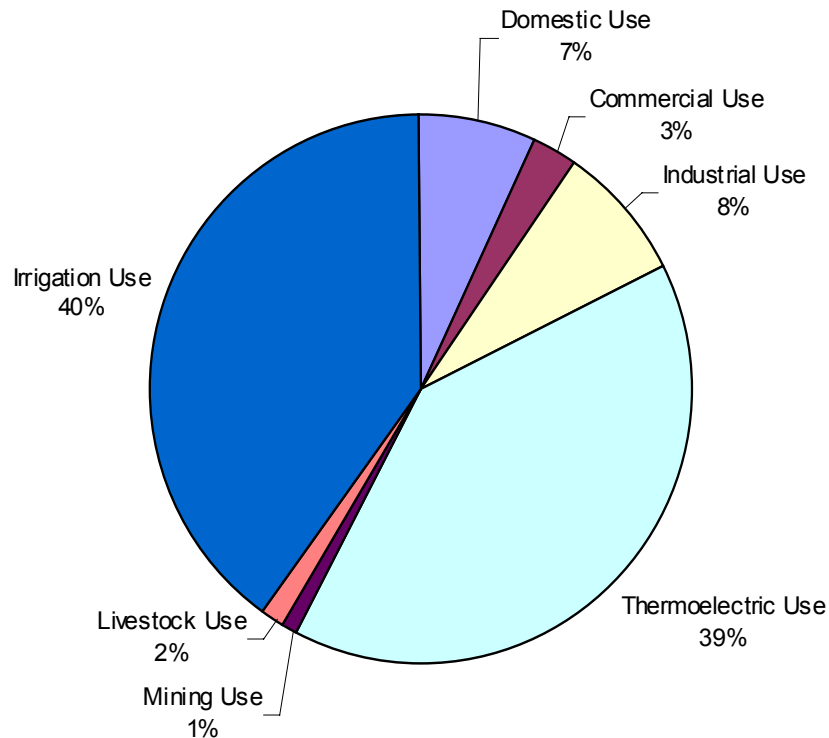
- Water & Sustainability (Volume 1): Research Plan (TR-1006784)
- Water & Sustainability (Volume 2): An Assessment of Water Demand, Supply, and Quality in the U.S.—The Next Half Century (TR-1006785)
- Water & Sustainability (Volume 3): U.S. Water Consumption for Power Production—The Next Half Century (TR-1006786)
- Water & Sustainability (Volume 4): U.S. Electricity Consumption for Water Supply & Treatment—The Next Half Century (TR-1006787)
- To order: 800-313-3774

Recent EPRI Energy/Water Sustainability Research Results



- A framework to evaluate demands and availability for electric power production within hydrologic units across the US: development and applications (in review).
- The formation and fate of trihalomethanes in power plant cooling water systems, EPRI 1009486, March 2004 (PIER funded).
- A survey of water use and sustainability in the US with a focus on power generation, EPRI 1005474, November 2003.
- Use of degraded water sources as cooling water in power plants, EPRI 1005359, October 2003 (PIER funded).
- Spray cooling enhancement of air-cooled condensers, EPRI1005360, September 2003 (PIER funded).

Sustainability Indices

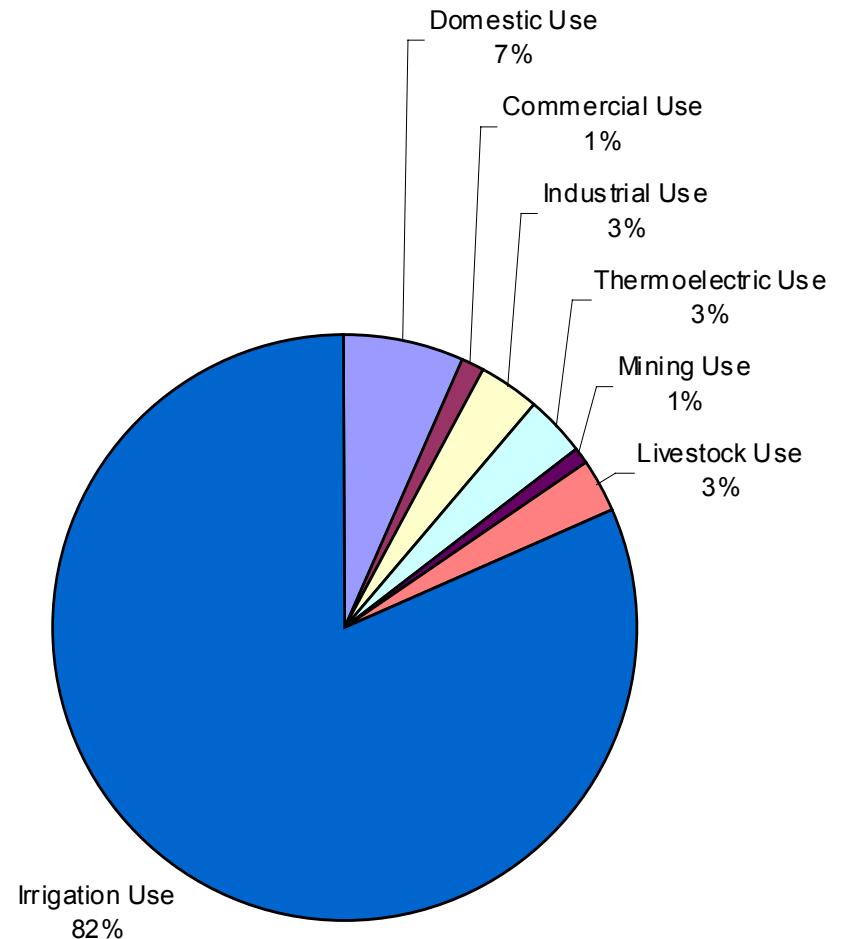


Freshwater Withdrawal (1995)

- Water Supply Sustainability Index
- Thermoelectric Cooling Constraint Index
- Based on easily accessible data
- Include multiple assumptions
- Unquantified uncertainties
- Basis for more detailed analysis of sustainability issues
- A Survey of Water Use and Sustainability in the United States with a Focus on Power Generation (EPRI 1005474)

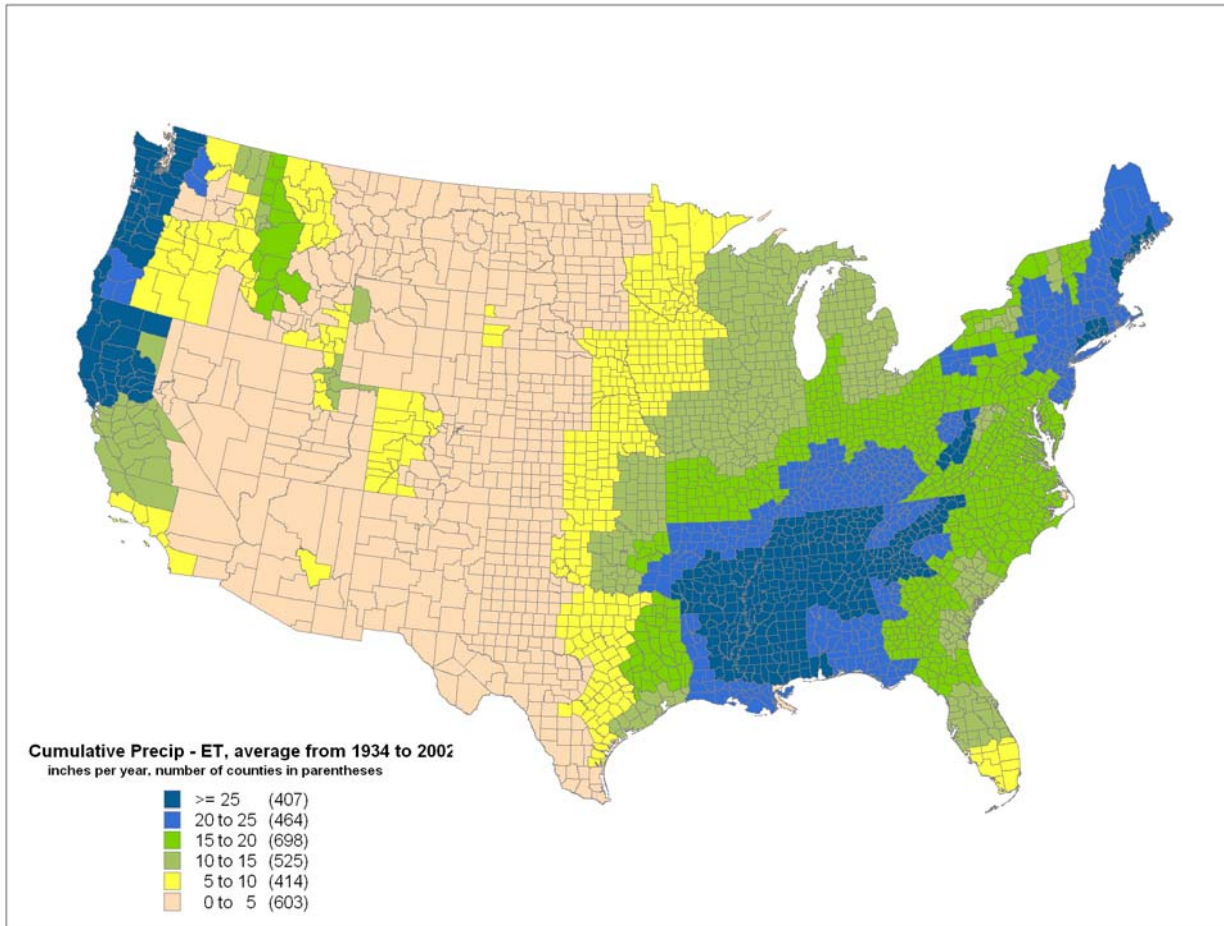
Data Sources

- US Geological Survey
- NOAA
- US Department of Agriculture
- US Census Bureau
- US Department of Energy
- USEPA

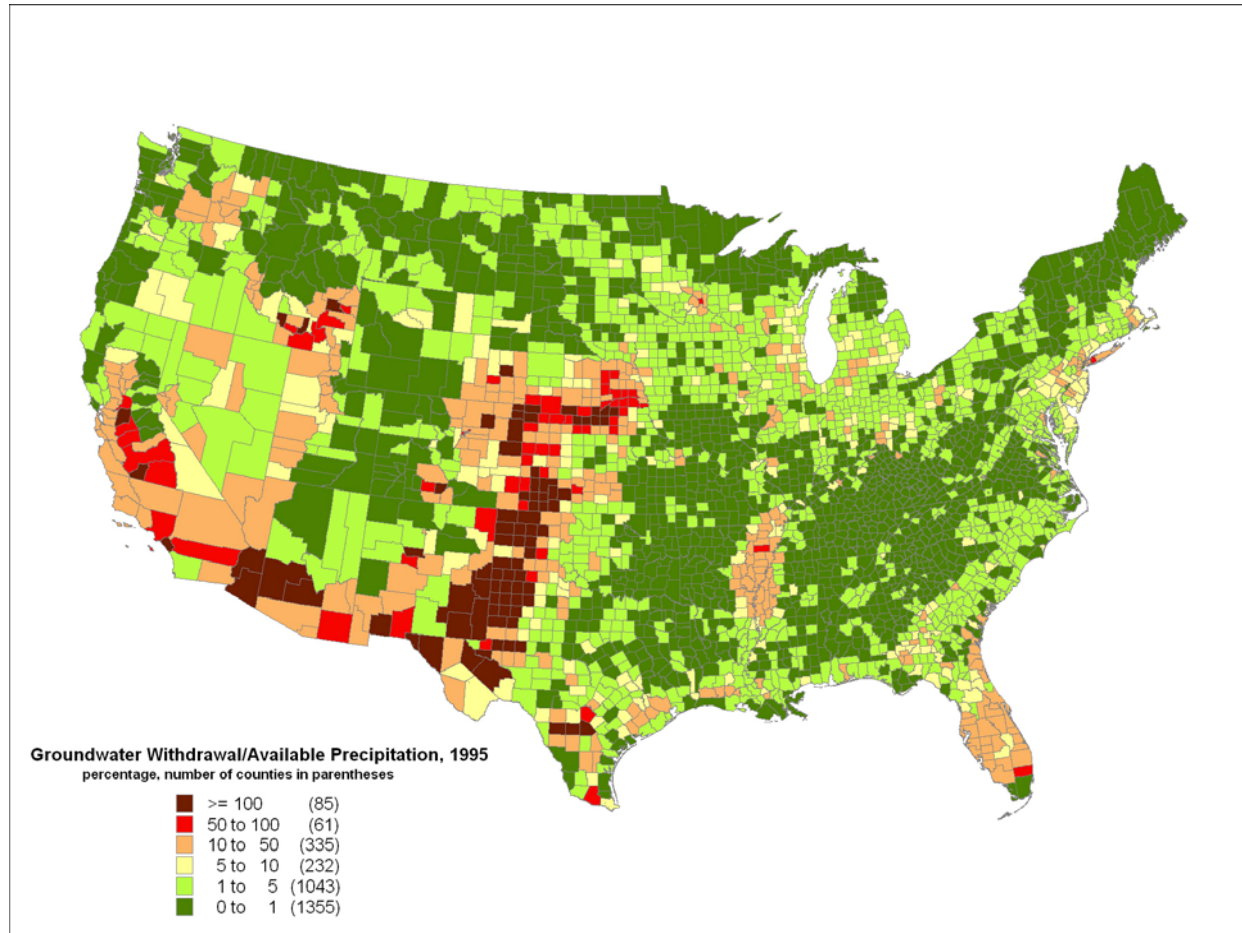


Consumptive Use (1995)

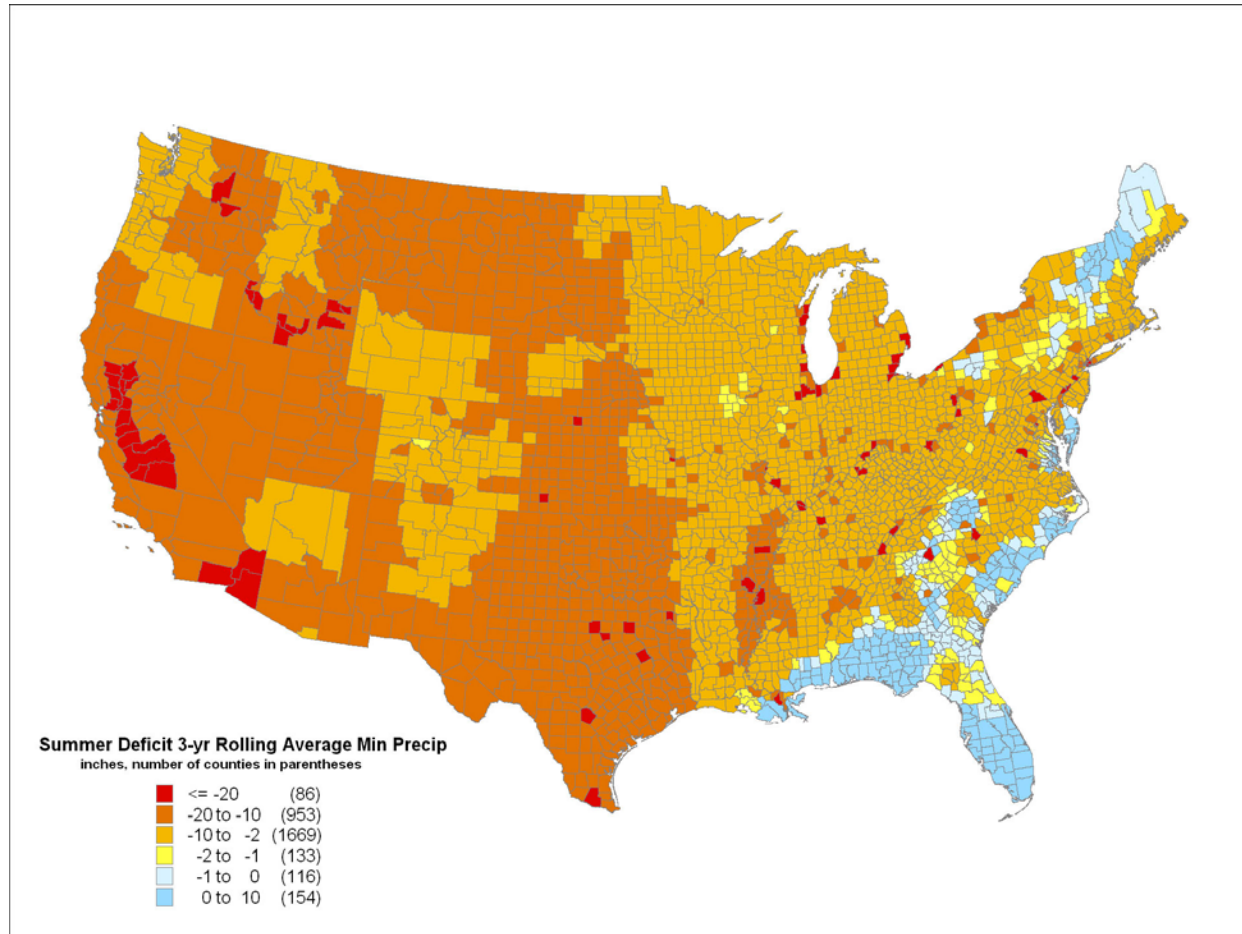
Annual Precipitation Minus ET, Average 1934-2002



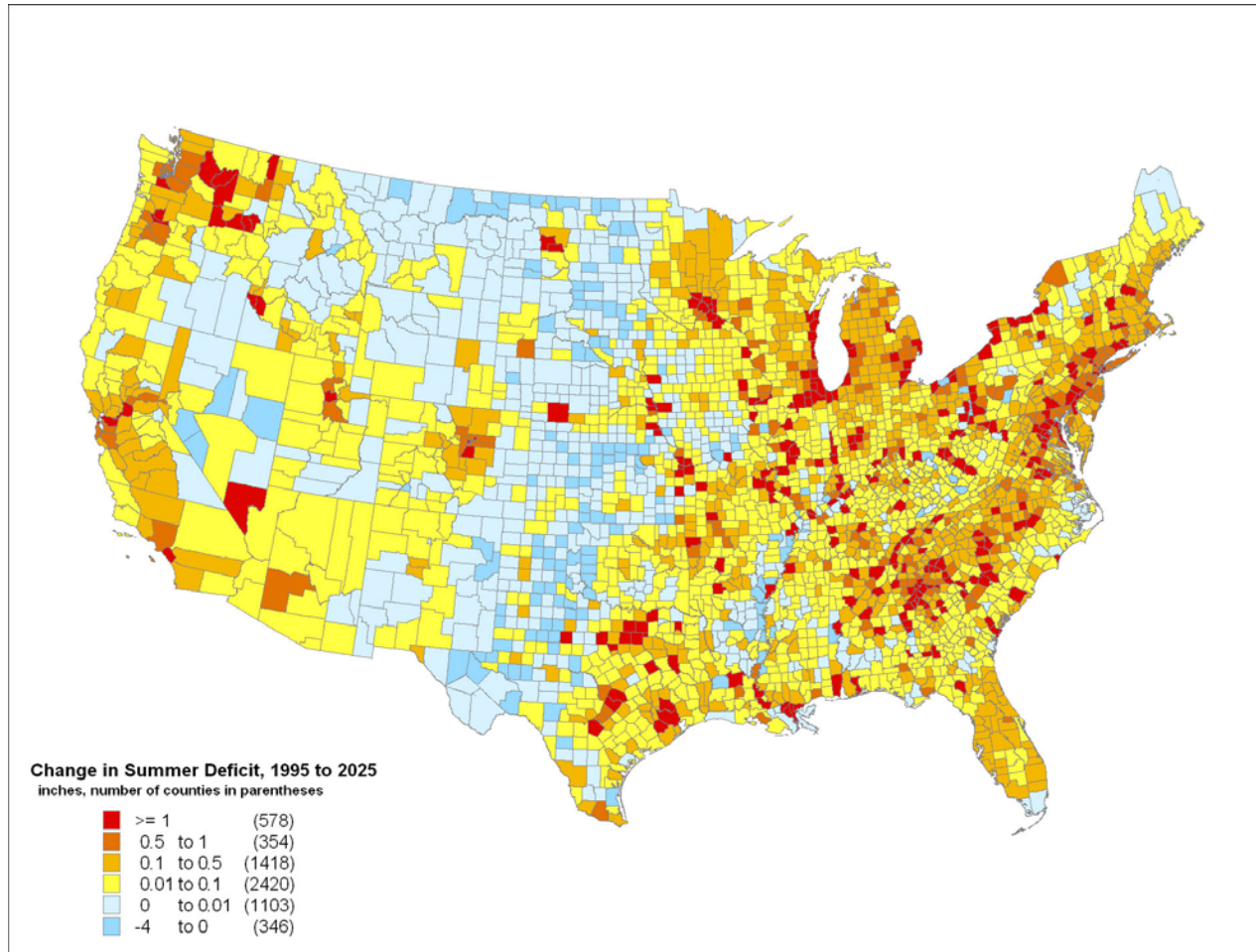
Groundwater Withdrawal/Available Precipitation (1995)



Summer Deficit 1995 Using 3-Year Rolling Average Minimum Precipitation



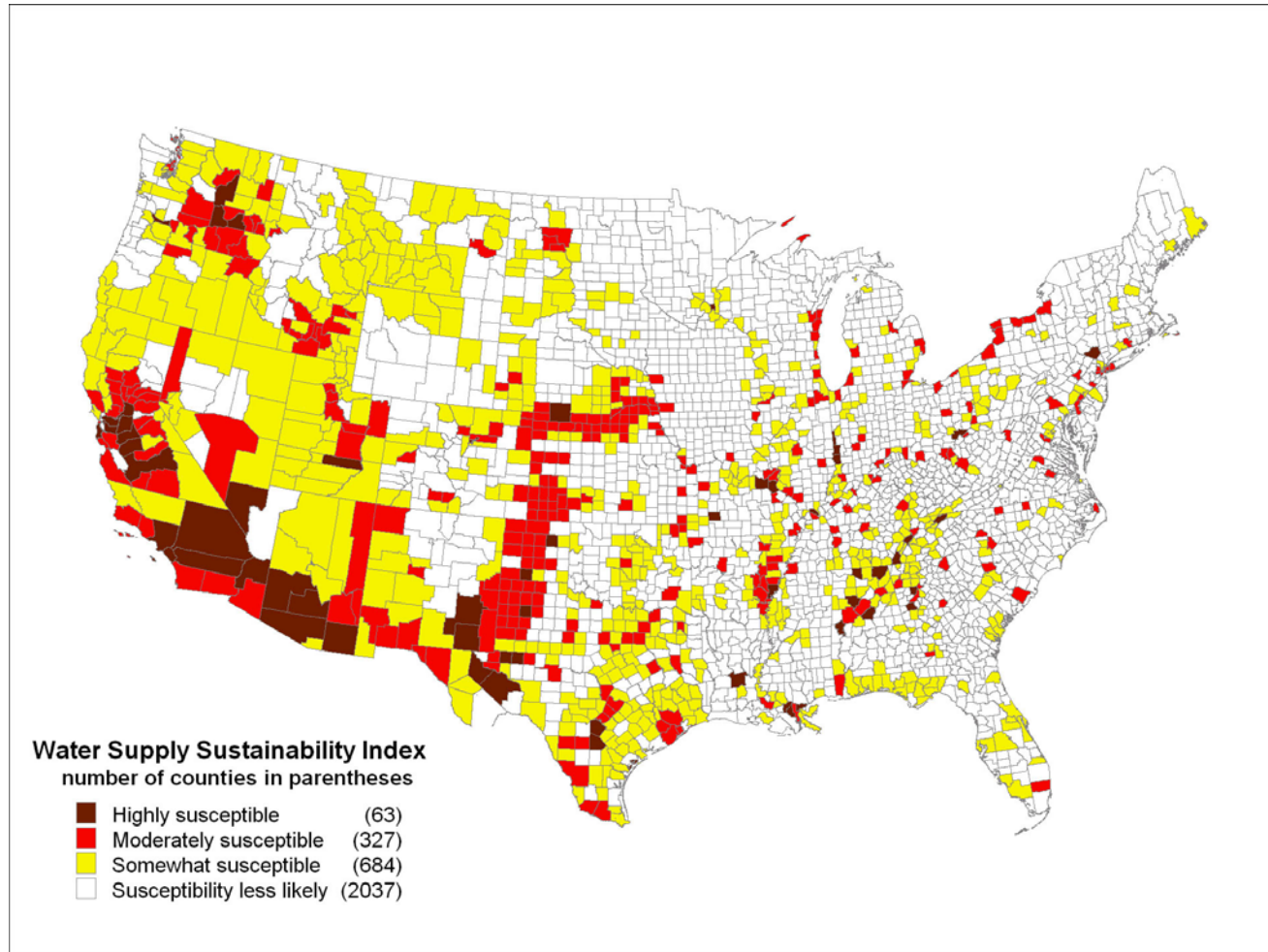
Change in Summer Deficit, Business as Usual, 1995-2025



Water Supply Sustainability Index (2025)

- Extent of development of available renewable water: use of available precipitation more than 25%
- Sustainable groundwater use: ratio of groundwater withdrawal to available precipitation more than 50%
- Environmental regulatory limits on freshwater withdrawals: number of aquatic endangered species more than 2
- Susceptibility to drought: summer deficit during low precipitation years more than 10 inches
- Growth of water use: Increase of freshwater withdrawals from 1995 to 2025 using business as usual scenario more than 20%
- New requirements for storage or withdrawal from storage: increase in summer deficit from 1995 to 2025 more than 1 inch

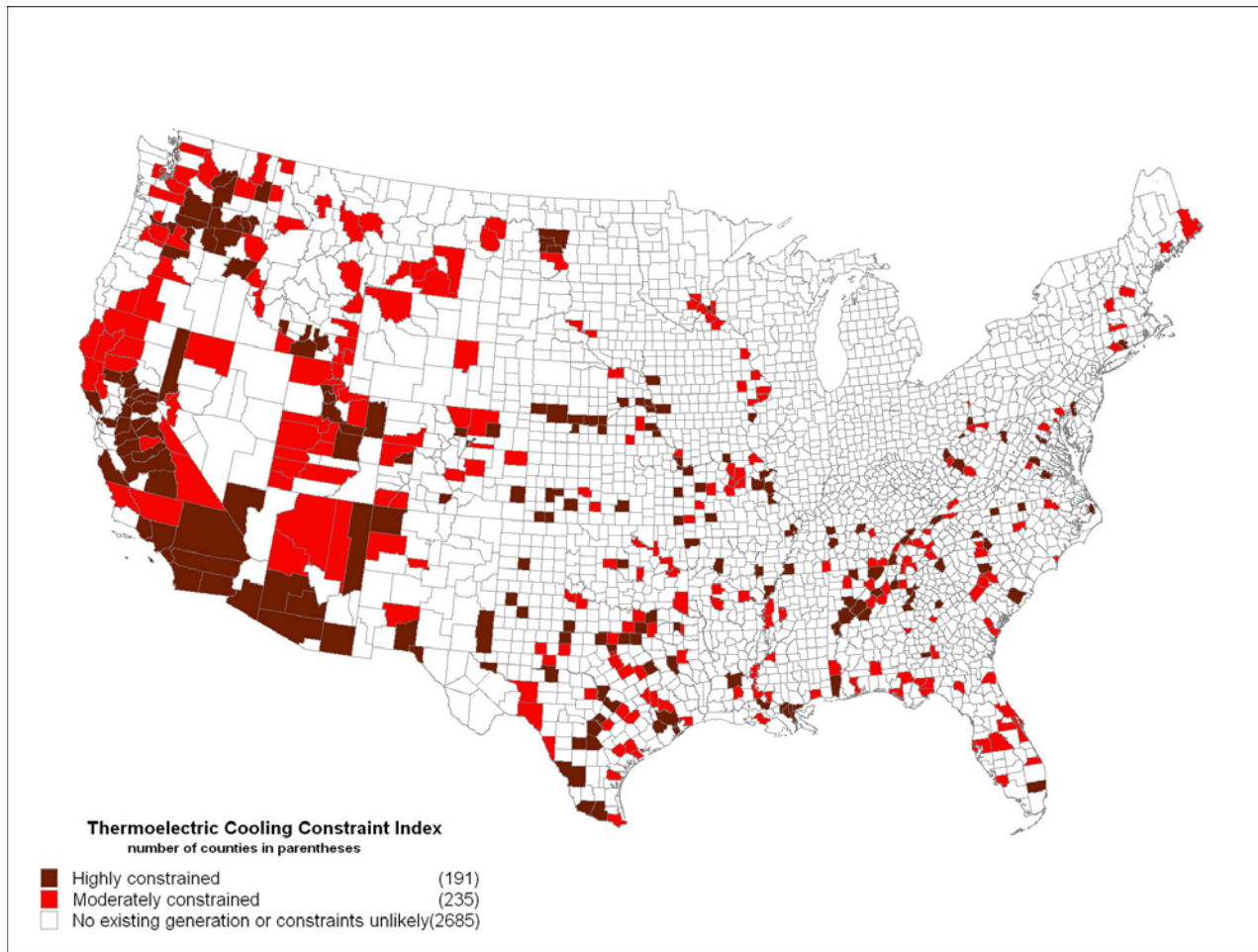
Water Supply Sustainability Index (2025)



Thermoelectric Cooling Constraint Index (2025)

- Water Supply Sustainability Index (WSSI)
- Growth in electricity generation from 1995 to 2025
- Highly constrained
 - WSSI is three or more
 - Generation increases by more than 50%
- Moderately constrained
 - WSSI is two or more
 - Generation increases by more than 50%

Thermoelectric Cooling Constraint Index 2025

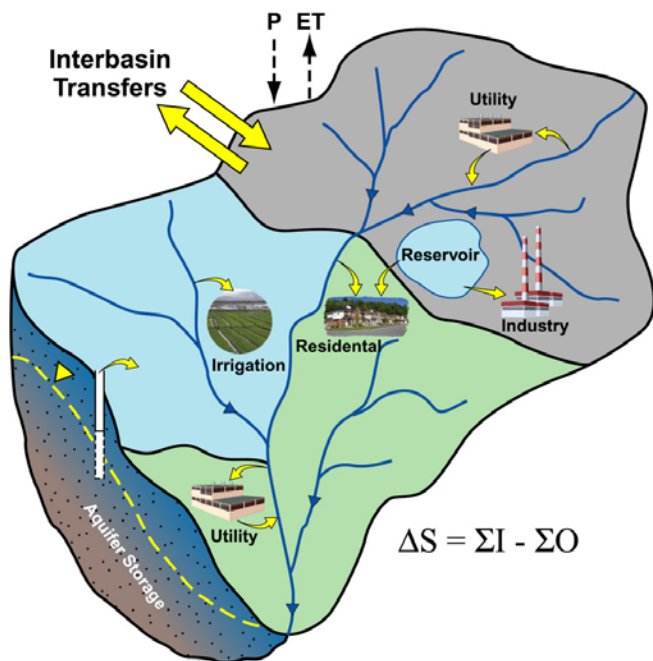


Sustainability Index Study Conclusions

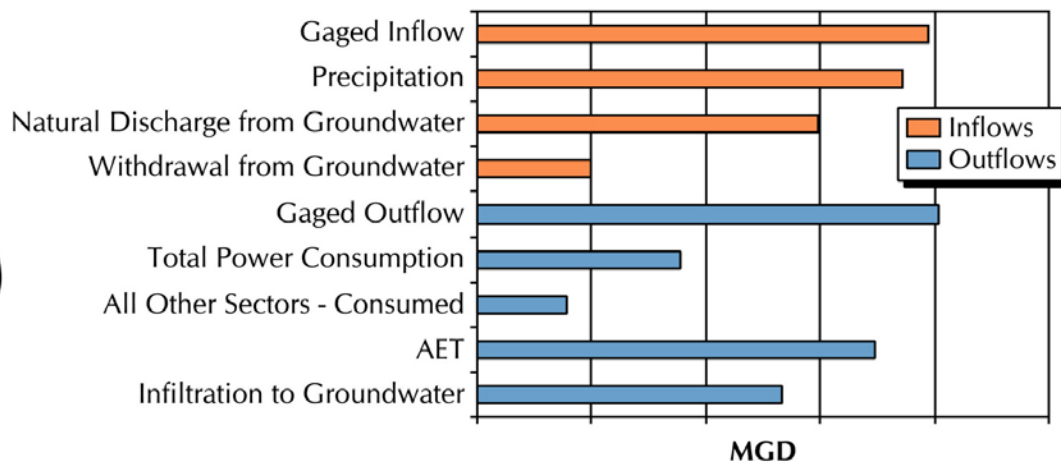
- First step to develop comprehensive framework to:
 - Evaluate possible impacts of water supply limitations on electric power generation
 - Manage approaches to limit these impacts
- Areas vulnerable to shortages of water availability and water-induced constraints on electric power generation occur throughout the U.S.
- Climate change and growing concerns about environmental protection may exacerbate the situation

Water Demands and Availability for Power Generation - Create Annual Water Budgets

Multi-Basin Water Uses, Storage, and Flows

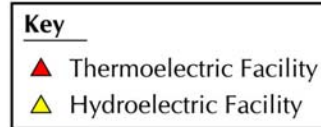
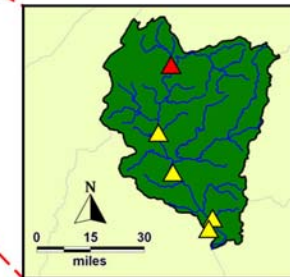
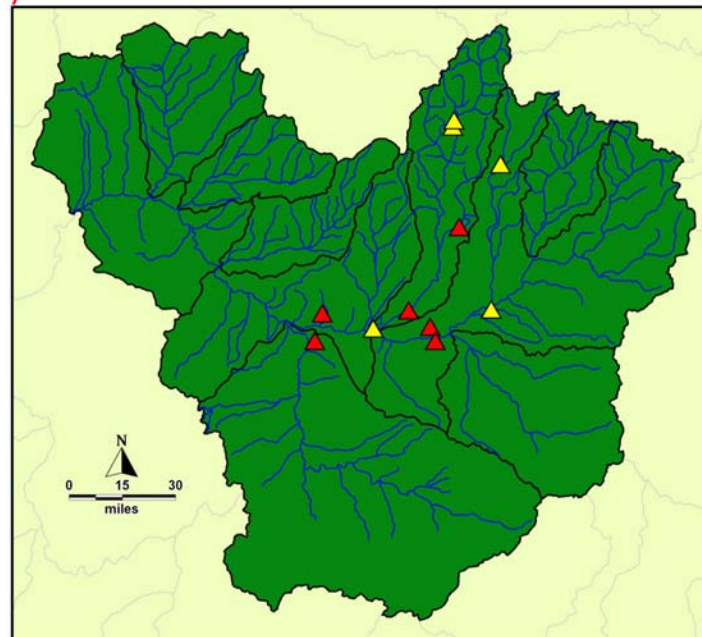
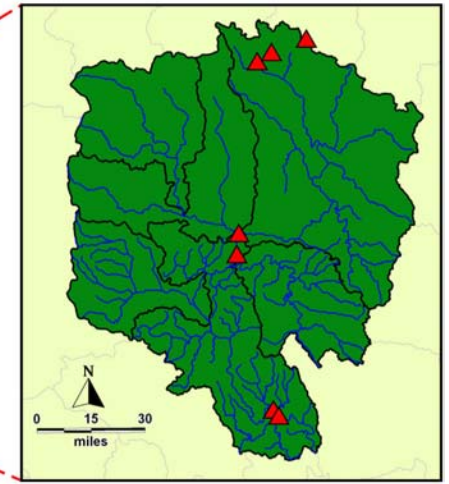
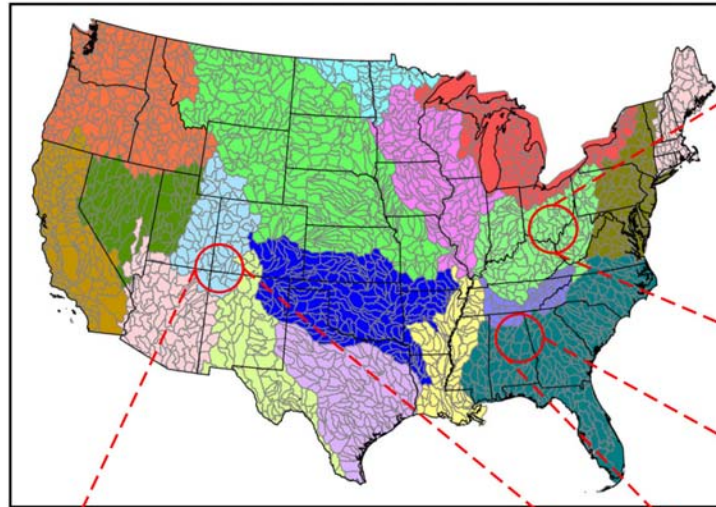


Typical Water Budget Components



**Case Studies:
Select
Hydrologic
Units for
Analysis**

**18 Water Resource Regions and
2156 Hydrologic Units (Code 8) in USA**



ZeroNet Initiative



- PNM, LANL and EPRI
- Goal: By 2010 achieve required electric power production and use in New Mexico with Zero-Net fresh water withdrawals for new capacity.
- Comprehensive/Integrated
 - Advanced cooling
 - Degraded water use
 - Efficiency, conservation, recycling and renewables
 - Landscape management
 - Economic and market mechanisms
 - Advanced monitoring
 - Modeling
 - Policy analysis
 - Education
- \$50M - 7 years

Questions?

